RECLAMATION

Managing Water in the West

CVP Cost Allocation Study
Public Meeting – Nov. 21, 2014
Power Proof-of-Concept

U.S. Department of the Interior
Bureau of Reclamation

Overview

- Evaluation of Power Benefits
- Traditional Approach
- Suggested Approach
- Proof-of-Concept
- Next Steps

CVP Power Benefits

- Economic Benefit
  - Alternative Cost
  - Market Value ≈ Incremental Cost
- Components
  - Capacity
  - On-peak and Off-peak Energy
  - Ancillary Services (Spin, Non-spin, Reg-up, Reg-Down)
  - Renewable Energy Credits (RECs)
- National or Regional Perspective
  - Western Interconnection, California Grid

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Traditional Approach

- Compare the differential costs for two scenarios:
  - With fully-functional CVP Portfolio
  - Without CVP Portfolio, but with replacement portfolio to ensure resource adequacy
  - Study is performed with CVP constraints modeled
- PLEXOS: Simulation of Market
  - On-peak & Off-peak Energy
  - Ancillary Services
- Capacity: Alternative Cost Method

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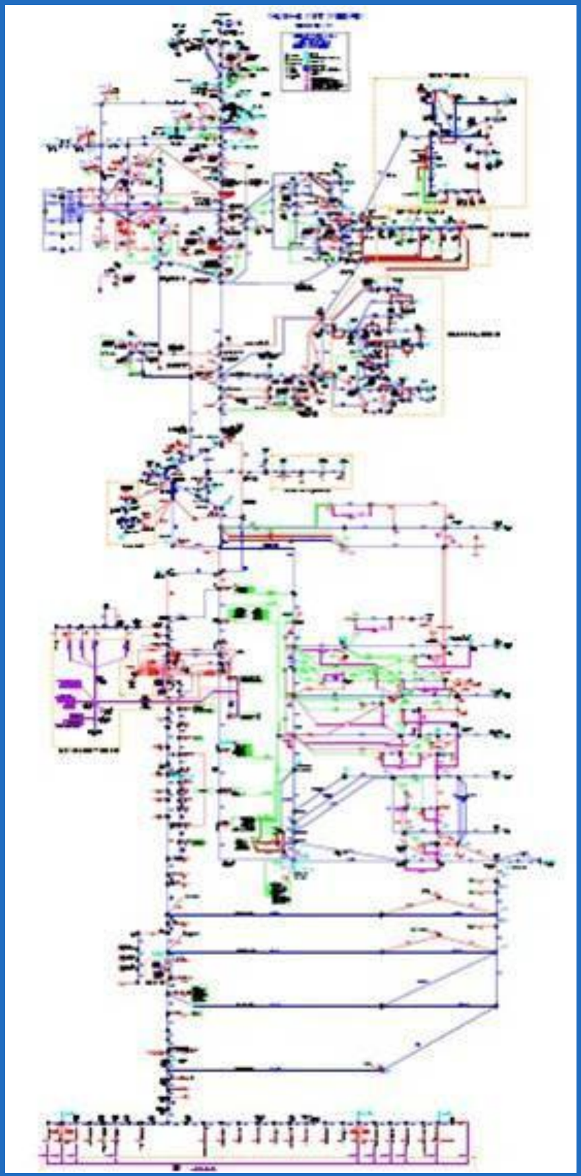
Suggested Approach

- CVP Energy Benefits
  - Market Rates X CVP Power Accomplishments
- CVP Power Accomplishments
  - Monthly CVP Generation & Capacity from CalSim Model
  - PLEXOS →
    - Hourly CVP Generation and Ancillary Services
    - Hourly Market Prices for Energy and Ancillary Services



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Proof-of-Concept

- CVP Capacity is ~2,100 MWs or 3 % of the overall California Market
- In THEORY, Absence or Presence of CVP should not significantly Impact Market Prices
- PLEXOS Model Runs to Test this Theory
- If Test Successful, power benefits to be valued through a Direct Application of forecasted Market Rates to CVP Power Accomplishments

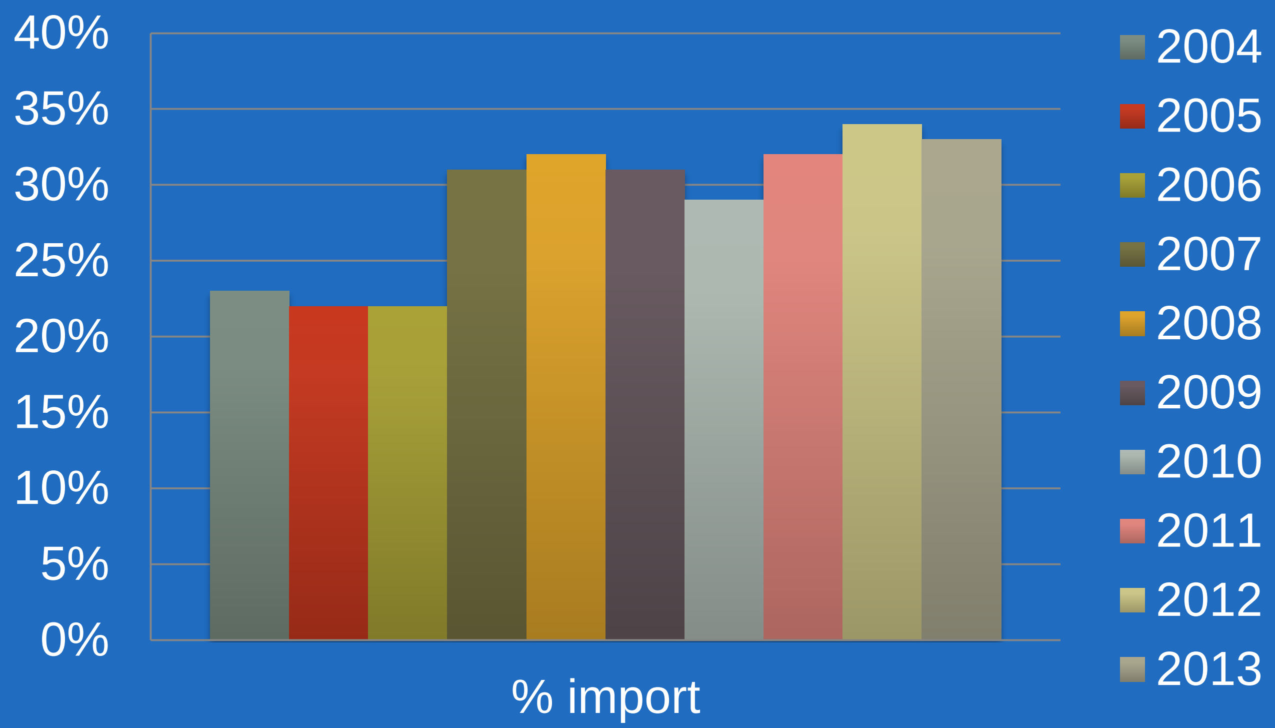
PLEXOS Model Runs

- **Purpose**
  - Test the impact of CVP portfolio on NP15 power prices
- **Simulation Database**
  - CPUC/CAISO Long-Term Procurement Plan (LTPP) 2012 Database
  - Study Year: 2022
  - Footprint: Entire Western Interconnection (Western Electricity Coordinating Council (WECC)) at zonal level
- **Scenarios**
  - Case 1: Existing Conditions with CVP Portfolio
  - Case 2: Without CVP Portfolio
  - Case 3: Without CVP, with Replacement Thermal Portfolio

Why Model WECC?

- About 30 % of CA energy requirements met by NW and SW imports
- Imports contribute to CA supply curve and reduce the market clearing price
- A credible CA market-price simulation needs to consider imports and all of WECC

NW & SW Imports into California



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Why 2012 LTPP Database?

- Well-vetted and Recent Database
- Used for Investor-Owned Utility Procurement
- Simulates:
  - CA hydro
  - CA transmission constraints
  - CA operating reserve requirements
  - CA must-run units
  - CA renewable resources
- Incorporates Input from CA IOUs, CAISO, CAPUC, CEC, and others

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Why 2022 for Study Year?

- LTPP database selected for CA detail and extensive vetting by CA power entities
- LTPP database focuses on a single simulation year, 10 years in the future
- 33% Renewable Portfolio Standard (RPS) Mandate will be achieved in 2020, so 2022 provides accurate picture of future resource mix
- Assumption that Market Stabilizes after RPS implemented

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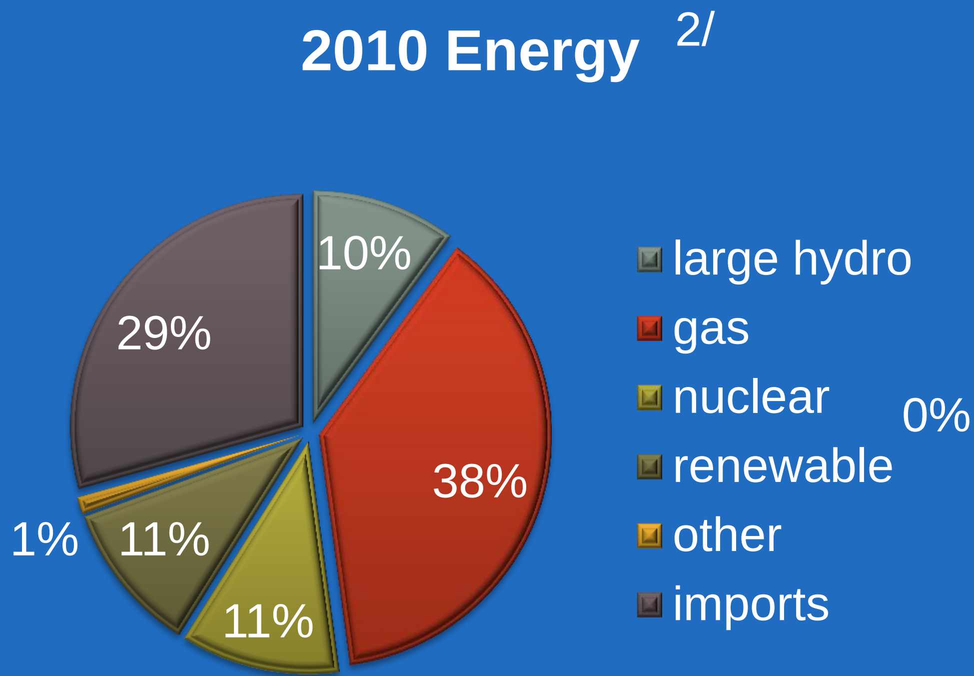
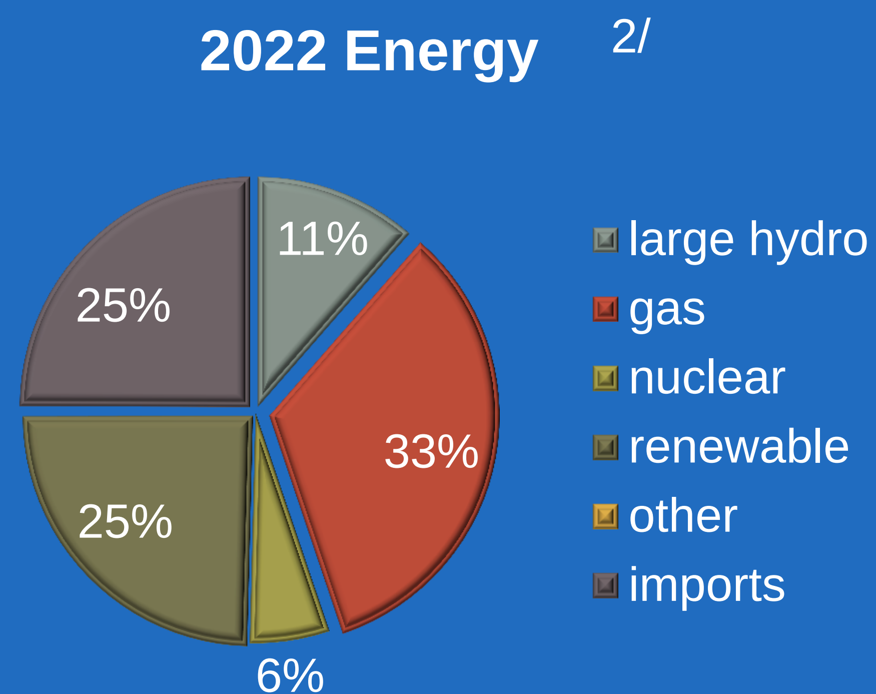
Change in Resource Mix from 2010 to 2022[1/]





[1/] 2010 is the most recent CA "normal" hydro year
[2/] Part of 33% RPS Mandate met from imported renewables

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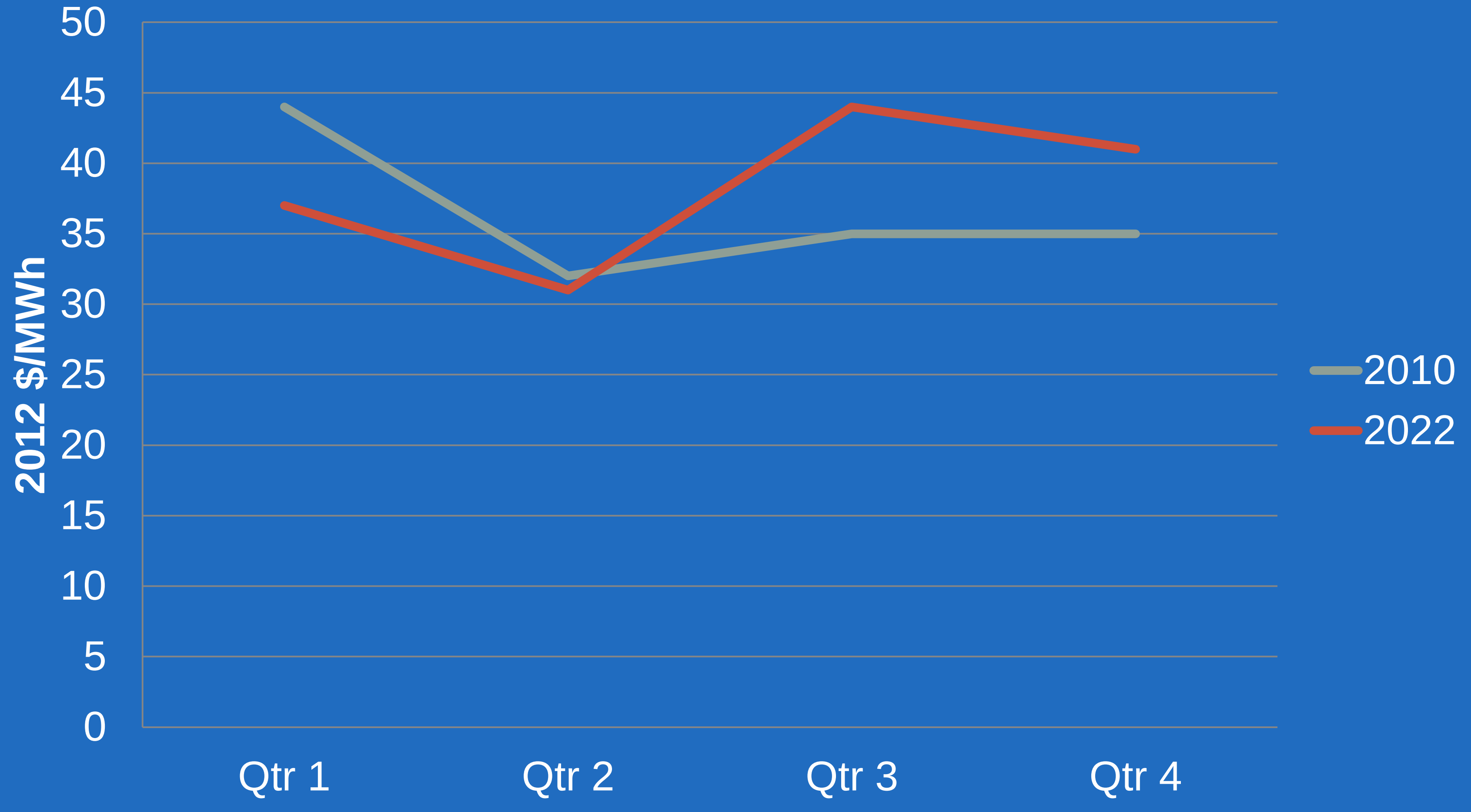
NP15 Prices for 2010 and 2022 *



*2010 and 2022 gas price are comparable in 2012 dollars

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Modeling Steps

- Start with 2012 LTPP Database
- Model CVP Generation
  - Average of 82 years of monthly Generation from CalSim
  - Generation disaggregated to Hourly using Recent Historical Dispatch for Normal Hydro Condition
- Case 1: Query NP15 prices for Existing System
- Case 2: Disable the CVP Portfolio & Rerun; Query new NP15 prices
- Case 3: Replace CVP capacity with Mix of Thermal Generators & Rerun; Query new NP15 prices

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CVP Portfolio

CVP Power Plant Capacities *		
Power plants	**Reservoir Storage** ***Per 1000 Acre Feet (TAF)***	**Capacity** **(MW)**
Folsom	1,000	215
Nimbus	8.8	17
New Melones	2,400	383
San Luis	900	202
O'Neill	Forebay	14
Shasta	4,500	710
Keswick	24	117
Trinity	2,400	140
Spring Creek	Tunnel, Clear Cr.	180
Judge Francis Carr	Tunnel, Lewiston	171
Total	**11,200**	**2,149**

**Reflects capacity at unity power factor*

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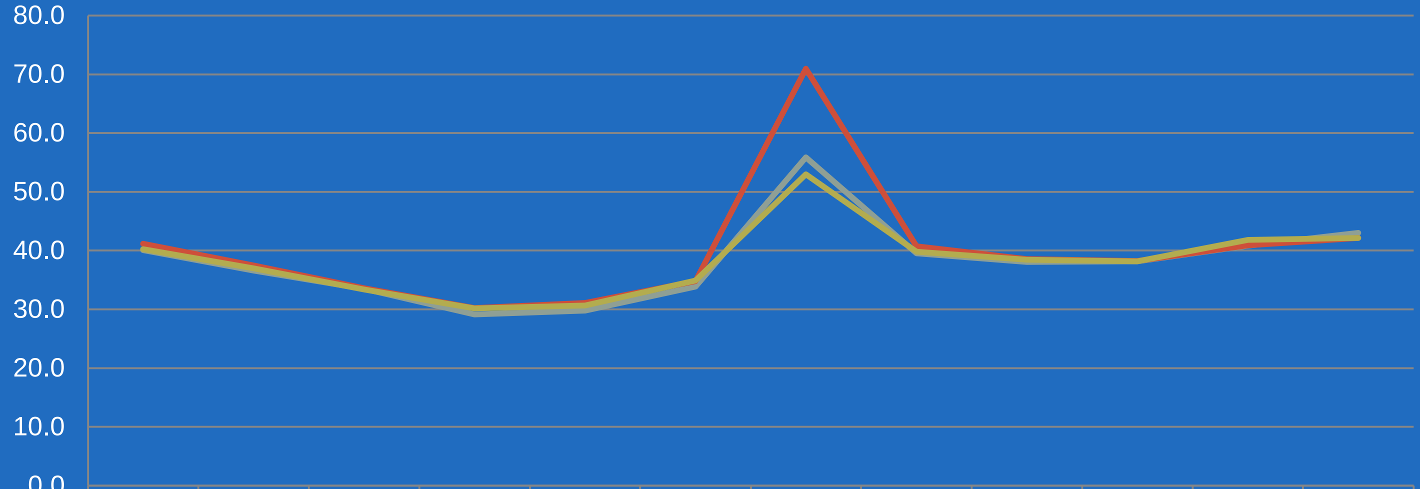
Thermal Replacement for CVP

- LTPP Database to inform Selection:
  - Use Similar Mix to Replacement for Once-Through-Cooling Generators to Maintain Local Capacity
  - 2425 MW of Combined Cycle (CC) and 2554 MW of Combustion Turbine (CT) added at roughly 50/50 Ratio
- Similar Mix for CVP Replacement Capacity of 2149 MW:
  - Two 570 MW CCs (7FA)
  - Ten 100 MW CTs (LMS 100)

PLEXOS Results

NP15 Price Comparison (2012$/MWh)



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Case 1	40.1	36.6	33.5	29.1	29.8	33.9	55.9	39.6	38.1	38.2	40.8	43.0
Case 2	41.2	37.5	33.6	30.2	31.1	34.8	70.9	40.7	38.6	38.2	40.9	42.2
Case 3	40.3	37.0	33.4	30.2	30.7	34.9	53.0	39.8	38.4	38.1	41.8	42.1

Case 1 : With CVP
Case 2: Without CVP
Case 3: Without CVP, with Thermal Replacement

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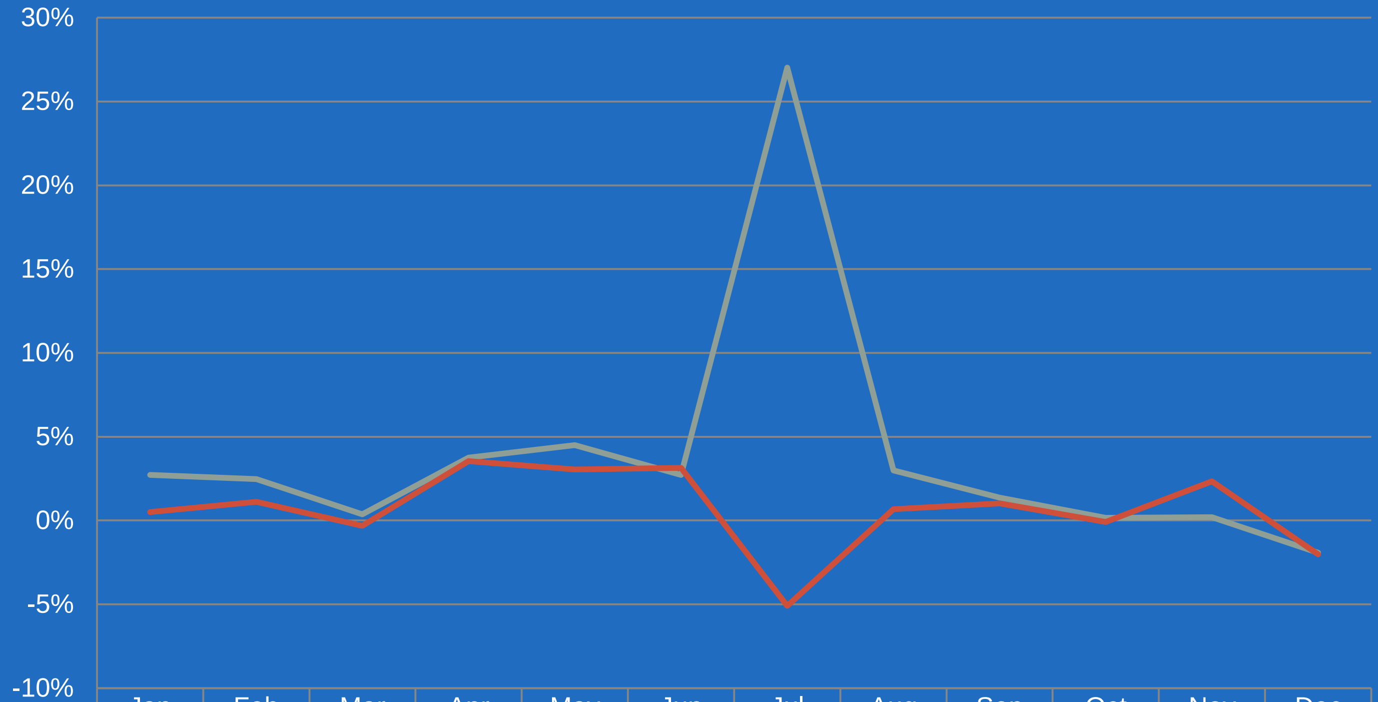
Results Comparison

Price Difference Against the Reference Price (%)



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Case 2 to 1	3%	2%	0%	4%	5%	3%	27%	3%	1%	0%	0%	-2%
Case 3 to 1	1%	1%	0%	4%	3%	3%	-5%	1%	1%	0%	2%	-2%

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Conclusions

- NP15 Prices not Significantly Affected with and without CVP Portfolio
- Resource Adequacy
  - Without CVP Portfolio, System Inadequate → Price Spikes
  - CA has 15 % Planning Reserve Margin Resource Adequacy Mandate
  - Thermal Replacement assures Resource Adequacy and Mitigates Price Spikes
- Proof-of-Concept SUCCESSFUL

Next Steps

- Evaluate CVP Power Benefits through Direct Application of Market Prices to CVP Power Accomplishments
  – Add Detail to PLEXOS to better Model CVP Power
    - Operating Constraints
    - On-peak & Off-peak Generation
    - Ancillary Services
- Value Capacity and Renewable Energy
  – Use Alternative Cost to Value Capacity
  – Value RECs for O’Neill and Nimbus

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